

CONSOLIDATING AND ADVANCING KNOWLEDGE OF THE CHEMICAL OCEANOGRAPHY OF THE ARCTIC OCEAN

Dr. Louis A. Codispoti
Center for Coastal Physical Oceanography
Crittenton Hall
Old Dominion University
Norfolk, VA 23529
lou@ccpo.odu.edu
Voice: (757) 683-5770 FAX: (757) 683-5550
Award No. N00014940682

LONG TERM GOALS

The long term goal of this project is to advance knowledge of the chemical oceanography and biogeochemical cycling of the Arctic Ocean with particular emphasis on changes that may be related to natural or man-related climate change and to man's impingement (i.e., pollution and changes in the hydrologic cycle).

OBJECTIVES

This particular project has 3 major objectives:

1. Facilitating the consolidation and dissemination of the scientific results of the Arctic Nuclear Waste Assessment Program (ANWAP).
2. Helping to ensure that chemical oceanographic data from the Arctic Ocean that were collected by the Former Soviet Union (FSU) do not disappear with the collapse of scientific infrastructure in the FSU.
3. Testing new instrumentation for autonomously collecting chemical oceanographic data from the Arctic Ocean and its adjacent seas.

APPROACH

Meeting objective #1 involves attending and helping to organize workshops, editing, reviewing, and writing. Meeting objective #2 involves interacting with FSU colleagues, personnel from the National Oceanographic Data Center and Peter Becker of Battelle. Meeting objective #3 involves selecting and testing instruments that, with modification, may be capable of making autonomous nutrient measurements under high-latitude conditions.

ACCOMPLISHMENTS

Under objective #1 this project supported the publication of a paper describing the Arctic Nuclear Waste Assessment Program (ANWAP) and its initial results (Edson *et al.*, 1997, see **Publications**). The P.I. also participated in the review of the ANWAP risk assessment document. Publications relating to the long term goal of the project include a paper by Devol *et al.* (1997) that discusses biogeochemical cycling in arctic shelf sediments, and a book review by Codispoti (see **Publications**). This project also provided support for an invited talk given by the Principal Investigator at the Gordon Research Conference on sea-ice ecology.

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Under the aegis of objective #2, modest support was provided to a research team in the Former Soviet Union to further their efforts to study primary production and ecosystem processes in ice-covered seas. It is hoped that this collaboration will lead to significant sharing of data and ideas on the biogeochemical cycling that occurs in the marginal seas of the Arctic Ocean.

During the past year, accomplishments under objective #3 include continued research into the suitability and availability of *in situ* devices for determining nutrient concentrations in arctic waters. A syringe sampler is in the final stages of construction, an *in situ* nitrate analyzer (NAS-2E) was purchased from WS Ocean Systems, and the shore-based laboratory equipment needed to test these devices has been purchased and is being set-up. Mr. Vincent Kelly, a graduate student at Old Dominion University, has been added to our team and he will concentrate his research efforts on optimizing and testing the WS Ocean Systems device with a view towards deployment in high latitude environments. Initial tests will include comparing the *in situ* results from this instrument with samples collected by the syringe sampler during co-deployments of both devices. Continued investigation of an instrument manufactured by Valeport that employs UV absorption to measure nitrate concentrations suggested that this device required additional development. Valeport has recently developed an improved instrument that may be capable of providing nitrate data with a frequency of about 1 Hz if it can be periodically calibrated against samples from the other types of samplers that we are working on. We continue to monitor progress of the UV-based instrument because of its potential for miniaturization and for obtaining high-frequency data, but interference from dissolved organic matter may still prove to be a significant issue.

SCIENTIFIC / TECHNICAL RESULTS

Specific scientific results include the direct determinations of wintertime denitrification rates in Arctic Ocean shelf sediments (Devol *et al.*, 1997). Our observations from summer and winter suggest that denitrification in arctic shelf sediments may be globally significant.

IMPACT FOR SCIENCE / SYSTEMS APPLICATIONS

If we are successful in providing *in situ* instruments for determining nutrient concentrations in high latitude waters, a powerful new tool will be provided for monitoring changes in hydrographic structure and biological processes in the Arctic Ocean. Recent data suggest the possibility of significant decadal-scale changes in currents and hydrography, and nutrient data provide one of the better ways of monitoring hydrographic conditions in the Arctic. Our demonstration of high wintertime denitrification rates in arctic shelf sediments suggests that biogeochemical cycling in the Arctic can probably not be entirely neglected when attempting to model global climate change.

TRANSITIONS

Our review of the ANWAP risk assessment document should help to transition the information of this program in a format that is useful for policy makers in agencies that deal with pollution, living resources, and human populations in the Arctic. The good news is that the results do not suggest a major threat to U.S. waters and citizens from the dumping of nuclear waste material in the Arctic by the FSU.

RELATED PROJECTS

None

PUBLICATIONS

- Yoshinari, T., M.A. Altabet, S.W.A. Naqvi, L.A. Codispoti, A. Jayakumar, M. Kuhland and A. Devol (1997) Nitrogen and isotopic composition of N₂O from suboxic waters of the eastern tropical North Pacific and the Arabian Sea - measurement by continuous flow isotope-ratio monitoring. Marine Chemistry 56:253-264.
- Edson, R., G.L. Johnson, L.A. Codispoti and T. Curtin (1997) The Arctic Nuclear Waste Assessment Program. Oceanography 10:4-10.
- Codispoti, L.A. (1997) Review of Upwelling in the Ocean: Modern Processes and Ancient Records. Marine Chemistry 56:133-134.
- Codispoti, L.A. (1997) The limits to growth. Nature 387:237-238.
- Devol, A.H., L.A. Codispoti and J.P. Christensen (1997) Summer and winter denitrification rates in western arctic shelf sediments. Continental Shelf Research 17:1029-1050.
- Morrison, J.M., L.A. Codispoti, K. Wishner, C. Flagg, W. Gardiner, S. Gaurin, S.W.A. Naqvi, V. Manghnani and L. Prosperie (submitted) The oxygen minimum zone in the Arabian Sea during 1995. Deep-Sea Research.
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- Smith, S., M. Roman, K. Wishner, M. Gowing, L.A. Codispoti, R. Barber, J. Marra, I. Prusova, and C. Flagg (submitted) Seasonal response of mesozooplankton to monsoonal reversals in the Arabian Sea. Deep-Sea Research.